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Point-of-sale tobacco promotion and youth smoking: a meta-analysis

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ABSTRACT

Introduction Previous systematic reviews have found consistent evidence of a positive association between exposure to point-of-sale (POS) tobacco promotion and increased smoking and smoking susceptibility among children and adolescents. No meta-analysis has been conducted on these studies to date.

Methods Systematic literature searches were carried out to identify all quantitative observational studies that examined the relationship between POS tobacco promotion and individual-level smoking and smoking-related cognitions among children and adolescents, published between January 1990 and June 2014. Random-effects meta-analyses were used. Subgroup analyses were conducted according to extent of tobacco POS advertising environment in the study environment. Sensitivity analyses were performed according to study size and quality.

Results 13 studies met the inclusion criteria; 11 reported data for behavioural outcomes, 6 for cognitive outcomes (each of these assessed smoking susceptibility). The studies were cross-sectional, with the exception of 2 cohort studies. For the behavioural outcomes, the pooled OR was 1.61 (95% CI 1.33 to 1.96) and for smoking susceptibility the pooled OR was 1.32 (95% CI 1.09 to 1.61).

Conclusions Children and adolescents more frequently exposed to POS tobacco promotion have around 1.6 times higher odds of having tried smoking and around 1.3 times higher odds of being susceptible to future smoking, compared with those less frequently exposed. Together with the available evaluations of POS display bans, the results strongly indicate that legislation banning tobacco POS promotion will effectively reduce smoking among young people.

INTRODUCTION

Tobacco promotions increase the likelihood that children and young people start smoking,[1 2] and make retail environments an important marketing medium for the tobacco industry. Based on data from the USA, most industry expenditure on tobacco promotion is allocated towards retail incentives.[3] These enable tobacco companies to communicate with consumers at the point-of-sale (POS) through advertising and product slotting in display units.[4 5] The tobacco industry argues that POS promotions encourage adults to switch brands rather than encourage uptake of smoking among non-smokers. Despite these claims, the research evidence suggests that young people exposed to tobacco brands at POS have more positive perceptions of people who use those brands[6] and higher brand recall.[7] As defined by the WHO Framework Convention on Tobacco Control, a 'comprehensive' ban on tobacco promotion includes the POS, since these are essentially forms of advertising.[8] As such, some jurisdictions, such as Ireland, Australia, Norway, New Zealand, Finland, the UK, Panama and Uruguay have banned POS tobacco promotions, and other forms of in-store advertising. However, most other countries, including the USA, continue to allow extensive retail tobacco promotions.[8]

Two systematic reviews have found consistent evidence of a positive association between exposure to POS tobacco promotion and increased risk of smoking, and smoking susceptibility among children and adolescents.[9 10] The consistency of findings across study designs, outcome measures and settings indicates this association is robust which, along with apparent dose–response effects, lends support to a causal inference. To date, there has been no published meta-analysis of the overall effect size of the association. Identifying the magnitude of the association may help policy-makers quantify the benefits of removing POS tobacco promotion. We therefore aimed to provide an estimate of the effect size of the association between POS tobacco promotion and smoking among children and adolescents.

METHODS

Literature search strategy

Literature searches were similar to those used previously[9 10] and were conducted in June 2014 using MEDLINE (OvidSP), Scopus and Web of Science. An initial search for the keywords 'tobacco' OR 'smoking' OR 'cigarette*' was conducted. A separate search was then conducted for the following terms, using the OR command between each keyword ('point-of-sale', 'point of sale', 'POS', 'point-of-purchase', 'point of purchase', 'POP', 'powerwall', 'retail' OR 'store'). Lastly a search was conducted with the following keywords ('youth', 'adolescent', 'teen*' OR 'child*'). These three searches were each combined using the AND command (eg, #1 AND #2 AND #3). The titles and abstracts of retrieved articles were reviewed by LR and references discarded if they were not related to tobacco control. The abstracts of the remaining references were reviewed by LR to identify whether articles were relevant and met the inclusion criteria below. The full text of each article was obtained where further clarification on the measures and study objective was needed. Further searches were conducted using the reference lists and 'cited by' lists of retrieved articles and through 'related article' searches on Google Scholar. The 2014 online editions of Tobacco Control and Nicotine and Tobacco Research were

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scanned for relevant articles. Searches were conducted by the lead author who, with CC, independently reviewed the articles for eligibility for inclusion.

Inclusion criteria

We included quantitative research published in a peer-reviewed journal between 1 January 1990 and 23 June 2014. Research was eligible if it included either self-reported or objective measures of exposure to POS tobacco promotion (eg, awareness of POS promotion, visits to stores where POS promotion was present or assessments of POS tobacco promotions within a specified study area). Cigarette brand awareness was included as a proxy measure for exposure to POS tobacco promotion only if it specifically related to the identification of brands in a retail setting. The inclusion criteria for outcome measures were individual-level smoking behaviour (experimentation, smoking initiation, regular smoking and cigarette purchasing behaviour) and smoking-related cognitions (eg, smoking susceptibility, cravings to smoke, perceived likelihood of future smoking, perception of peer smoking prevalence). Studies were eligible if the samples included children and adolescents aged 18 years old or younger. Only observational studies were included. We excluded experimental research as we wanted to assess naturalistic exposure to POS tobacco promotion rather than simulated exposures used in most experimental research.

Several potentially relevant articles identified during the literature search process did not meet inclusion criteria, including a study with a college student sample;[11] studies using an exposure measure that included but was not specific to POS marketing;[12 13] studies assessing the relationship between smoking and exposure to tobacco advertising in general,[14] and studies investigating access to tobacco retailers and smoking.[15 16]

Data extraction

A data collection form[17] was developed and piloted by LR and CC. Extracted data comprised: study authors, publication year, data collection year, study design (cross-sectional vs cohort), country, outcome measure, participant age group, sample size, OR and 95% CIs, whether the OR was adjusted or not, and the POS tobacco promotion context (ie, studies conducted in environments where only POS tobacco displays were permitted at the time of data collection were scored a '0'; those in environments that permitted retail tobacco promotions in addition to tobacco displays were scored a '1'). LR and CC independently extracted the required data from each article; these were subsequently compared for accuracy, and any discrepancies were resolved by discussion between LR and CC. For studies with multiple exposure measures, we prioritised more objective measures (eg, store-visiting frequency) over subjective measures (eg, attraction to POS displays), selecting these ORs for the meta-analysis. Where multiple outcome measures were reported in a single article, we prioritised smoking status (ie, being a current smoker or ever-smoker) over other behavioural variables (eg, cigarettes per day, purchasing-related measures), and we prioritised smoking susceptibility among never-smokers over other cognitive variables. Where ORs were not reported, we calculated unadjusted ORs using the descriptive data provided in the article. Where an article provided multiple ORs for data collected at more than one time point, we decided a priori to use data for the most recent year. The exception to this was the cohort study that provided ORs at both 12-month and 30-month follow-ups[18]; we decided that the 12-month OR should be used as this estimate would be most comparable to those in the remainder of the research (since these were mostly cross-sectional studies, along with one other 12-month cohort study). Where an article provided multiple ORs due to the use of categorical exposure data,[19] these were combined into a single overall estimate by running a meta-analysis on the ORs and CIs presented. We called this a 'within-paper' meta-analysis and it provided a single estimate for that particular analysis. Where an article provided multiple ORs in stratified analyses, such as by geographic area or age group, these were combined to provide a single OR for the overall study. Where an article provided multiple ORs in statistical models that adjusted for different covariates, we selected the OR that had been adjusted for the greatest number of variables.

Quality assessment

A quality score was assigned to each article as a way of assessing risk of bias; we used the Newcastle-Ottawa Quality Assessment Scale (NOQAS)[20] for cohort studies, and a modified version for cross-sectional studies (see online supplementary file 1). Studies were awarded a maximum of two points if they controlled for the most important potential confounding factors; we deemed these to be SES and smoking by family members AND peers, since we theorised that these factors would be most likely to be associated with both the exposure and outcome. We also allowed a score of 0.5 to be given for exposure measures assessed via written self-report but that were objective (eg, store-visiting frequency) compared with the self-reported exposure measures we considered much more subjective (eg, noticing tobacco displays). This approach differentiated quality within the studies insofar as the measurement of exposure was concerned, since all studies used written self-report as means of assessing exposure. The overall scores for cohort and cross-sectional studies were adjusted to give each study a total score out of 10. The lead author, LR, assigned quality scores to each study; these were then reviewed and corroborated by RM.

Statistical analyses

Random-effects meta-analyses were performed. A random-effects model is the most appropriate model to use with meta-analyses of observational studies, as it assumes the studies are each estimating their own effect rather than a 'true' effect that a fixed-effects model would assume (and that may be more applicable to RCTs). Separate analyses were performed for the behavioural (11 studies) and the cognitive outcomes (6 studies). We conducted a subgroup analysis for the two tobacco POS advertising environments for each of those two study types. Sensitivity was examined through analysing the studies according to quality (5 or below compared with more than 5 out of 10) and study size (up to 10 000 participants, more than 10 000). Metaregression was used to determine any significant differences between the subgroups (quality and study size). Funnel plots were created to investigate the possibility of publication bias. Statistical analyses were performed using Stata V.13 (using metan and metareg commands).[21]

RESULTS

Results of literature search

The initial literature searches yielded 1121 potential articles (see online supplementary figure S1). Of these, 13 were judged to have met the inclusion criteria and were reviewed in full. These included 5 of the 10 studies on children and youth included by Paynter and Edwards,[10] 6 of the 9 studies included by Robertson *et al*,[9] and an additional 2 studies subsequent to the search dates in the reviews (see online supplementary table S1). Eleven articles reported associations for behavioural outcomes (table 1), and six for cognitive outcomes (table 2); four studies

Table 1 Characteristics of observational studies examining association between impact of POS tobacco promotion and behavioural smoking outcomes among children and adolescents

First author, reference	Year published	Year data collected	Country	Study design	Average age of sample (years)	Sample size	Exposure	Outcome	Adjustments	POS context score	NOQAS score (10 maximum)	OR (95% CI)
Braverman[24]	2004	1995	Norway	Cross-sectional	13–15	4065	Self-reported recent exposure to retail tobacco promotion	Smoking status (daily, occasional, non-smoker)	SES; ethnicity; gender; smoking by family; smoking by friends	0	2	2.07 (1.73 to 2.49)
Dauphinee[25]	2013	2006	USA	Cohort; 12 months	11–15	1179	Self-reported store-visiting frequency	Ever-smoking (vs never-smoking)	Gender; ethnicity; school year; survey year; school performance; unsupervised days after school; risk-taking propensity; smoker at home; friend who smokes	1	7	1.15 (1.04 to 1.27)
Feighery[26]	2006	2003	USA	Cross-sectional	11–14	2063	Self-reported store-visiting frequency	Ever smoking (vs never-smoking)	SES; ethnicity; gender; smoking by family; smoking by friends; unsupervised time	1	5	2.01 (1.54 to 2.62)
Henriksen[27]	2004	2003	USA	Cross-sectional	11–14	2125	Self-reported store-visiting frequency	Ever smoking (vs never-smoking)	SES; ethnicity; gender; smoking by family; smoking by friends; exposure to other tobacco marketing	1	5	1.50 (1.10 to 2.10)
Henriksen[18]	2010	2003	USA	Cohort; 12 months	11–14	1182	Self-reported store-visiting frequency	Transition from never-smoking to ever-smoking	School year; gender; ethnicity; racial minority; academic performance; being unsupervised after school; risk-taking propensity; parent smoking; sibling smoking; exposure to smoking on TV/ movies; perceived exposure to retail tobacco advertising	1	7	2.06 (1.32 to 3.21)
Kim[22]	2013	2004–2008	USA	Cross-sectional	9–17	46 894	Mean no. of cigarette adverts per store at county level	Current smoker	Age; ethnicity; gender; student income; school smoking prevalence; living with smoker; county of residence; year of survey	1	8	0.96 (0.84 to 1.10)
Paynter[19]	2009	2007	New Zealand	Cross-sectional	14–15	27 757	Self-reported store-visiting frequency	Current smoker	Age; gender; ethnicity; peer smoking; parental smoking; smoking in the home; school SES	0	7	1.73 (1.19 to 2.50)
Schooler[28]	1996	1994	USA	Cross-sectional	13	571	Self-reported frequency of noticing retail tobacco promotion	Ever smoking	NA	1	2	2.98 (2.01 to 4.41)
Slater[23]	2007	2003	USA	Cross-sectional	14–18	26 301	Observational assessments of tobacco promotion in stores	Transition from never-smoker to 'puffer'	School grade, gender, ethnicity; resides with both parents; student income; parental education; urbanisation; state-level tobacco control policies; year of data collection	1	6	1.08 (1.02 to 1.14)
Spanopoulos[29]	2013	2011	UK	Cross-sectional	11–15	5376	Self-reported store-visiting frequency	Ever smoking (vs never-smoking)	Gender; ethnicity; school year; academic performance; rebelliousness; parent smoking; sibling smoking; perceived peer smoking prevalence; SES	0	7	1.64 (1.14 to 2.34)
Watanabe[30]	2013	2008–2009	Japan	Cross-sectional	15–18	540	Self-reported store-visiting frequency	Current smoker	Parental smoking	1	2	6.73 (2.00 to 22.60)

NA, not available; NOQAS, Newcastle-Ottawa Quality Assessment Scale; POS, point-of-sale; SES, socioeconomic status.

Table 2 Characteristics of observational studies examining association between impact of POS tobacco promotion and smoking susceptibility among children and adolescents

First author	Year published	Year data collected	Country	Study design	Average age of sample (years)	Sample size	Exposure	Outcome	Adjustments	POS context score	NOQAS score (10 maximum)	OR (95% CI)
Dube[31]	2013	2011	USA	Cross-sectional	11–18	3043	Self-reported exposure to retail tobacco promotion	Smoking susceptibility among never-smokers	School grade, sex, ethnicity, exposure to peer smoking, exposure to smoking at home	1	4	1.35 (0.88 to 2.07)
Feighery[26]	2006	2003	USA	Cross-sectional	11–14	1642	Self-reported store-visiting frequency	Smoking susceptibility among never-smokers	SES; ethnicity; gender; smoking by family; smoking by friends; unsupervised time	1	5	1.25 (0.98 to 1.61)
Kim[22]	2013	2004–2008	USA	Cross-sectional	9–17	42 138	Mean number of cigarette adverts per store at county level	Smoking susceptibility among non-smokers	Age; ethnicity; gender; student income; school smoking prevalence; living with smoker; county of residence; year of survey	1	7	1.03 (0.89 to 1.20)
Mackintosh[32]	2012	2008	UK	Cross-sectional	11–16	905	Self-reported frequency of noticing retail tobacco promotion	Smoking susceptibility among never-smokers	Age; gender; SES; sibling smoking; close friend smoking; parent smoking; attraction to PoS displays	0	6	1.77 (1.15 to 2.73)
Paynter[19]	2009	2007	New Zealand	Cross-sectional	14–15	15 071	Self-reported store-visiting frequency	Smoking susceptibility among never-smokers	Age; gender; ethnicity; peer smoking; parental smoking; smoking in the home; school SES	0	7	1.68 (1.37 to 2.06)
Spanopoulos[29]	2013	2011	UK	Cross-sectional	11–15	1204	Self-reported store-visiting frequency	Smoking susceptibility among never-smokers	Gender; ethnicity; school year; academic performance; rebelliousness; parent smoking; sibling smoking; perceived peer smoking prevalence; SES	0	7	1.20 (0.91 to 1.58)

NOQAS, Newcastle-Ottawa Quality Assessment Scale; POS, point-of-sale; SES, socioeconomic status.

reported both behavioural and cognitive outcomes. Of the studies assessing behavioural outcomes, seven examined ever-smoking, whereas four used being a current smoker as an outcome. Of the studies assessing cognitive outcomes, all examined smoking susceptibility, though five used a sample of never-smokers, while one used non-smokers (hereafter, we refer to the cognitive outcomes as 'smoking susceptibility'). All studies except two[22 23] used self-reported exposure measures, though seven used a more objective self-report question (ie, store-visiting frequency). Eight studies were conducted in the USA, three in Europe, one in New Zealand and one in Japan. Two were cohort studies and the remainder were cross-sectional.

Results of meta-analysis

As shown in figure 1, for the 11 studies examining behavioural outcomes, the pooled OR was 1.61 (95% CI 1.33 to 1.96). For studies examining smoking susceptibility, the pooled OR was 1.32 (95% CI 1.09 to 1.61; figure 2). Overall, there was significant heterogeneity between the studies, both in the behavioural outcome subset (I^2 91.3%, p=0.000) and the smoking susceptibility subset (I^2 70.7%, p=0.005).

Subgroup analyses indicated higher ORs in 'restricted POS environment' study jurisdictions, where the only form of POS tobacco promotion was the tobacco display. For behavioural outcomes, the OR in 'restricted POS environment' jurisdictions was 1.93 (95% CI 1.66 to 2.24) compared with 1.50 (95% CI 1.23 to 1.83) for the remaining studies. Similarly for smoking susceptibility, the OR in 'restricted POS environment' jurisdictions was 1.51 (95% CI 1.18 to 1.92) compared with 1.13 (95% CI 0.97 to 1.32) for the remaining studies. Metaregression indicated that the difference in ORs between the two POS promotion environments was not statistically significant for either behavioural or smoking susceptibility studies.

Sensitivity analyses were performed by (1) comparing large studies (10 000 participants or more) with smaller studies (less than 10 000), and (2) comparing studies that scored low on quality (5 out of 10 or below) with those that scored more highly (more than 5). Metaregression showed that there was no difference in the effects for the study size in either the behavioural or the cognitive group of studies. There was some indication (p=0.03) that the OR for higher quality studies was significantly lower than that for the lower quality studies in the behavioural group of studies: the OR for studies with a quality score of 5 or below was 2.14 (95% CI 1.68 to 2.74) compared with 1.22 (95% CI 1.06 to 1.40). There was no evidence of a similar difference in the smoking susceptibility studies. The funnel plots were asymmetrical for both the behavioural studies (see online supplementary figure S2) and smoking susceptibility studies (see online supplementary figure S3).

DISCUSSION

The results of this meta-analysis indicate that the odds of having tried smoking are around 1.6 times higher for children and young people who are frequently exposed to POS tobacco promotion, compared with those who are less frequently exposed. Similarly, the odds of being susceptible to future smoking among never-smokers are approximately 1.3 times higher for children and young people frequently exposed to POS tobacco promotion, compared with those less frequently exposed.

In each study, the reported ORs were consistent in their direction. The exception was the study by Kim *et al*,[22] which used an ecological design, where the exposure measure was county-level estimates of POS tobacco advertising and promotions, rather than individual-level exposure. This approach may have masked individual variation in actual exposures, which, if non-differential, would have biased the results towards the null, and may account for the non-statistically significant ORs. This may also apply to the study by Slater *et al*[23] which also used a population-level exposure measure that could plausibly have contributed to an effect size lower than those reported in the

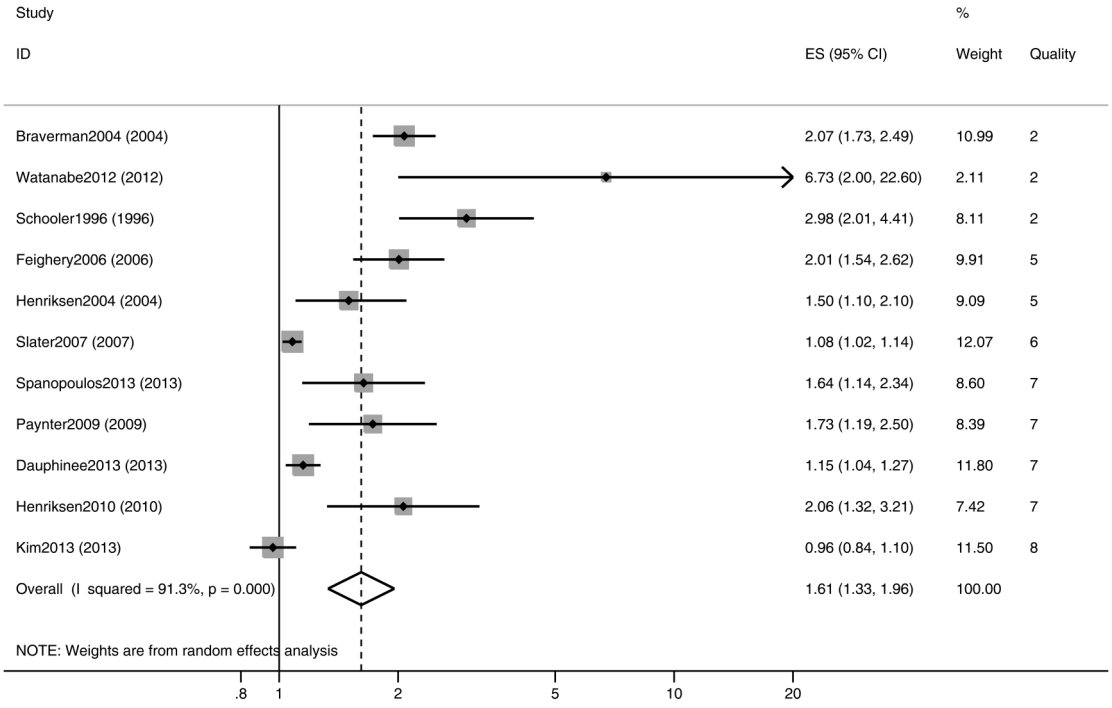

Figure 1 Forest plot of observational studies examining association between impact of point-of-sale tobacco promotion and behavioural smoking outcomes among children and adolescents (ES, effect size).

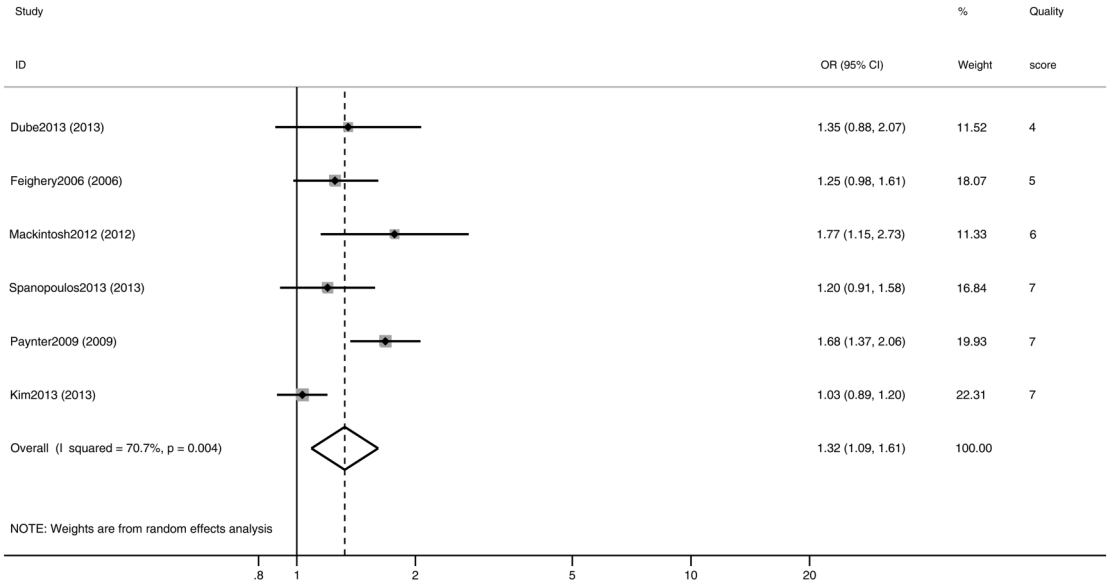

Figure 2 Forest plot of observational studies examining association between impact of point-of-sale tobacco promotion and smoking susceptibility among children and adolescents.

other studies. While the higher quality studies show a smaller effect size for the studies using behavioural outcomes, the OR (OR 1.22, 95% CI 1.06 to 1.40) was in the same direction as the overall pooled OR, and is consistent with the inference that exposure to POS tobacco promotion is associated with higher odds of being a smoker or of having tried smoking.

Subgroup analyses indicated that there was no statistically significant difference in the effect size between jurisdictions where the only form of retail tobacco promotion is the tobacco product display and those that allowed more extensive POS tobacco promotions. This finding implies that any type of in-store tobacco advertising—whether signage, posters or the product display—is associated with increased odds of smoking and smoking susceptibility. To be effective, bans on POS tobacco promotion should therefore cover both in-store advertising, such as brand or price promotions, as well as the display unit featuring cigarette packs.

The tobacco industry previously criticised research on POS advertising for supposedly showing 'small' effect sizes.[33] Yet the overall pooled ORs in this meta-analysis are comparable in size to those of other well-accepted risk factors for youth smoking. These include having a parent who smokes (OR 1.72),[34] and exposure to protobacco marketing and media in general (ORs 1.51–2.23).[35] Furthermore, this industry criticism overlooks the important point that at a population-level—and particularly at a global level—small-to-moderate effect sizes accumulate to produce highly meaningful outcomes. Our findings are concerning because children and young people's exposure to POS tobacco promotion is likely to be almost universal in jurisdictions without a POS tobacco promotion ban, given the widespread availability and promotion of tobacco.[8] A recent modelling study suggests that banning POS tobacco promotion in the USA would reduce smoking prevalence by approximately 16% by the year 2065, thus preventing around 630 000 smoking attributable deaths, 215 000 low birthweight infants, 140 000 preterm births and 1900 infant SIDs-related deaths in the USA.[36]

The main limitation to this meta-analysis is that, with the exception of two cohort studies,[18 25] the studies included were cross-sectional, thus limiting a causal inference. However, as noted previously,[9] the use of the smoking susceptibility outcome in cross-sectional studies provides greater confidence about the causal influence of POS tobacco promotion on smoking risk, compared with current smoking or ever-smoking. Being a current smoker or ever-smoker can plausibly cause more store visits or greater awareness of POS tobacco promotion; therefore, any observed associations can theoretically be explained by reverse causality. Evidence of an association between POS promotions and smoking susceptibility among never-smokers is compelling because these individuals are not smoking, which means tobacco purchasing is highly unlikely to be a cause of greater exposure to POS tobacco promotion. The relationship can plausibly only run in one direction and thus supports the conclusion that exposure to POS tobacco promotions fosters smoking susceptibility. There is a possibility that the associations observed in the studies are confounded by some uncontrolled variable. For example, it is theoretically possible that young people who frequently visit stores selling tobacco differ in some way that predisposes them to initiate smoking. We also note there is some evidence that publication bias may be present in the studies included in this meta-analysis, as indicated by the asymmetry in the funnel plots. If publication bias was present, it may have resulted in an overestimation of the pooled effect size. However, we cannot conclude this bias is present with certainty, as heterogeneity in the data is one of several other possible explanations for the asymmetry observed.

Existing research consistently demonstrates a positive association between exposure to POS tobacco promotion and youth smoking initiation and susceptibility, across countries, study designs and outcome and exposure measures. This meta-analysis indicates that exposure to POS tobacco promotion is a statistically significant risk factor for youth smoking. This finding has important public health implications, given that tobacco availability and promotion at the POS is ubiquitous in many jurisdictions. Together with evidence that newly implemented POS display bans reduce youth smoking susceptibility and denormalise smoking,[37 38] our results strongly indicate that legislation banning tobacco POS promotion will effectively reduce smoking among young people.

What this paper adds

- Two systematic reviews have found consistent evidence of a positive association between exposure to point-of-scale (POS) tobacco promotion and increased risk of smoking, particularly in relation to smoking susceptibility among children and adolescents.
- No meta-analysis has been conducted on these studies.
- The odds of having tried smoking are around 1.6 times higher for children and young people frequently exposed to POS tobacco promotion, compared with those who are less frequently exposed. This overall effect appears similar in size to other well-accepted risk factors for youth smoking.

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